

**TI 151A** Installation of Controller Module.

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## **1.0 PURPOSE AND APPLICABILITY**

This standard operating procedure (SOP) describes the procedure for installing an IMPROVE controller module at a site. This data has been relegated to a technical note since, while IMPROVE controller modules do exist in the IMPROVE network, no more are being built for new installations. The controller modules have been replaced by sampler/controller modules called controller module A's.

## **2.0 RESPONSIBILITIES**

### **2.1 Field Technician**

The field technician shall:

- Connect the IMPROVE controller module to power.
- Connect the controller module to the sampling modules.
- Test the controller module.

### **2.2 Local Contact**

The local contact shall:

- Provide site access and installation assistance as needed.

### 3.0 REQUIRED EQUIPMENT AND MATERIALS

The equipment required to wire an IMPROVE controller module for sampling are as follows:

- 1 aerosol sampler controller, the IMPROVE Controller Module, mounted on the support structure at the site.
- Module A (PM<sub>2.5</sub> sampler collecting samples for elemental analysis), mounted on the support structure at the site. Plus, up to 3 additional aerosol sampling modules:
  - Module B (PM<sub>2.5</sub> sampler collecting samples to analyze for nitrate, nitrite, sulfate and chloride)
  - Module C (PM<sub>2.5</sub> sampler collecting samples to analyze for carbon)
  - Module D (PM<sub>10</sub> sampler)
  - Module D/S (PM<sub>10</sub> sampler with a second stage analyzed for SO<sub>2</sub> gas)
- wiring harness to connect the aerosol sampling modules to the controller module.
- Pump house with contactor box containing relays to switch the pumps.
- Tool kit with 8" and 10" adjustable crescent wrench, channel lock pliers, needle nose pliers, cutting pliers, standard 1/4" through 11/16" combination wrench set, Phillips and flat-head screwdrivers, wire snips, line powered drill, standard drill bit set, 1.25" and 1.5" hole saws for use with drill, wire ties, electrical tape, Teflon plumbers tape, hammer, tape measure, level.
- A connection site for 110 V, 60 Hz power.
  - For an outdoor site, in the form of a three wire insulated cable in buried Liquitight™ conduit. One end will be connected to an "open" 20 Amp breaker, the other will be at the sampler installation location, protected by wire nuts.
  - For an indoors site:
    - a. In the form of a 20 Amp breaker inside the structure near the sampler installation location.
    - b. In the form of a four plug outlet at the sampler installation location. The outlet must have an exclusive 20 Amp breaker, though that may be located elsewhere.

## 4.0 METHODS

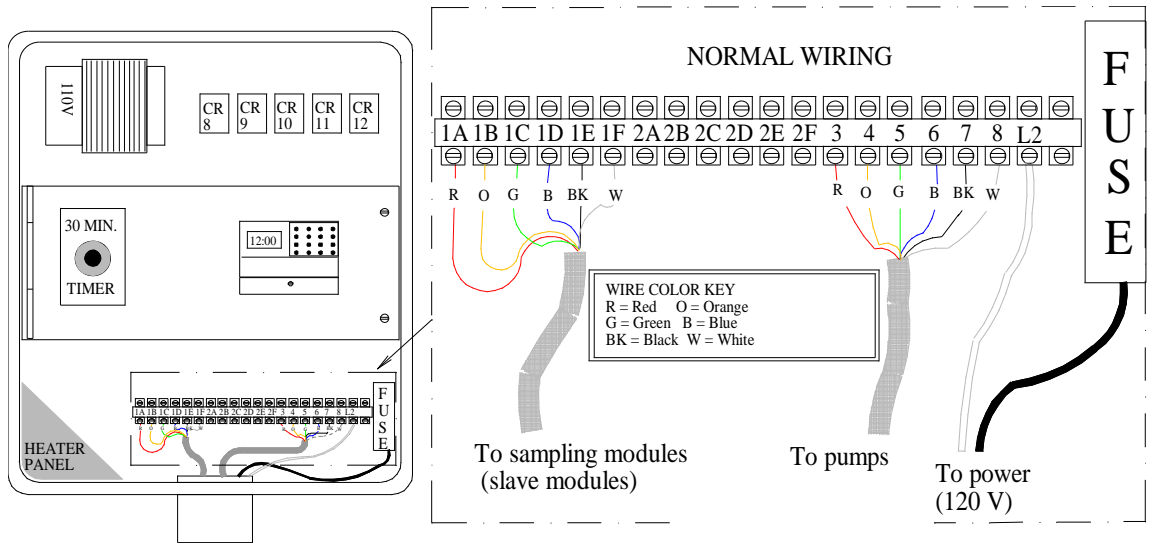
The IMPROVE Controller Module, Figure 4.1, is a separate module containing the controller clock, fuses, relays, and transformers to control sampling initiation. The controller module was designed in 1987, since when a new controller module version, the controller module A, a combined sampler and controller, was developed. However, many sites still use the IMPROVE controller modules, and they are preferred for outdoors installations.

The IMPROVE controller module is used in conjunction with a pump house having a contactor box. The pump switching relays are located in the pump house contactor box, and the power for the site runs first to the contactor box and spare outlets in the pump house. The controller module is wired to the contactor box and connected via 1 1/2" conduit. A few IMPROVE controller modules have been modified to run without the pump house, but these are rare, and are adequately described by the controller module A installation instructions.

The sampling modules are connected to a controller module via a six wire cable harness. Once connected to the controller, the sampler is tested for functionality. Wiring instructions are as follows:

1. Make sure the breaker is in the open position so no power can run through the power cable.
2. Install the pump house 10' from the sampler stand.
3. Cut the 3/8" Liquitight™ conduit to the appropriate length, leaving several extra inches of insulated power cable, to attach it to the pump house using the fittings and pre-drilled hole in the base of the pump house contactor box.
4. Cut the insulated power cable to fit within the contactor box and strip the ends of the three wires (black, white and green).
5. Connect the black and white wires to the terminal strip in the contactor box, as shown in the schematic C76-NPS-2420, and connect the green wire to the grounding screw.
6. Lay out the 16' length of 1 1/2" electrical conduit and connect it to the fittings in the center of the base of the pump house.
7. Thread three 20' lengths of wire, one black, one white, and one green, through the 16' electrical conduit, leaving 2' of wire inside the pump house.
8. Thread the black, white and green wires through the hole in the side of the pump house into the contactor box. This hole will already have a 20' length of gray six wire electrical cable threaded through it from the contactor box.
9. Connect the black, white and green wires from the conduit to the terminal strip in the contactor box in the same positions as the wires from the breaker, as shown in the schematic C76-NPS-2420.
10. Thread the 20' length of gray six wire electrical cable from the contactor box through the 16' length of 1 1/2" electrical conduit.
11. Thread one length of vacuum tubing for each sampling module through the 16' conduit, leaving three feet extending into the pump house. The shortest length of vacuum tubing, for the module nearest to the controller module, will be 21'. For each additional module, the length of the vacuum tubing must be increased by 2', such that the second closest sampling module would need a vacuum line 23' long.

**Figure 1 IMPROVE Controller Module Wiring Drawing**



12. Attach a conduit T to the bases of the IMPROVE controller module and each of the sampling modules, installing them along the width axis of the modules, such that conduit may be run between them.
13. Connect the 16' length of conduit from the pump house to the T on the base of IMPROVE controller module, threading the black, white, and green wires, and the gray six wire electrical cable up into the controller module. The vacuum tubing lines should pass straight through the T toward the first module.
14. Connect the black wire to the base of the fuse (there will be a locking fitting) as shown in Figure 4.1. Connect the white wire to position L2 on the terminal strip (again using the screw lock fitting). Connect the ground wire to the grounding screw in the lower right hand corner of the controller module back plate.
15. Slice open the end of the gray six wire electrical cable from the pump house, and strip the ends of the wires. Attach the wires to the terminal strip as shown in Figure 4.1.
16. A gray six wire cable harness is shipped coiled inside the controller module, already attached to terminal strip locations 1A through 1F of the controller module, as shown in Figure 1. Thread the free end through the T at the base of the IMPROVE controller module so that it runs toward the sampling modules.
17. Cut a length of conduit to fit between the T of the controller module and the T of the nearest sampling module (module A).
18. Thread the gray six wire electrical cable harness and the vacuum tubing through the section of conduit and through the T on the base of the sampling module.
19. Feed the first free set of panduit connectors on the six wire electrical cable into the next (closest) aerosol sampling module through the hole in the bottom of the module.

20. Connect the panduit connectors to the pins of the terminal strip on the right side of the module in the order Red, Orange, Green, Blue, Black, White, starting from the bottom of the terminal strip.
21. Thread the shortest length of vacuum tubing into the sampling module through the Tee on the base of the module.
22. Use a sharp knife or razor blade to cut the vacuum tubing to reach the brass elbow located above the critical flow orifice. Cut the tubing cleanly and straight across its diameter. To connect the vacuum tubing to the brass elbow, slip a brass compression fitting over the end of the vacuum line, then tighten it to the brass elbow with a 5/8" wrench. This will seal the fitting to the vacuum hose. Extra brass vacuum line compression fittings are included in ziplock bags attached to the vacuum tubing.
23. Cut a length of conduit to fit between the T of the current sampling module and the T of the next sampling module, or, if there are no more modules, put a cap on the open end of the Tee.
24. Repeat steps 18 through 23 until all the modules are connected to the controller module.
25. Turn on the power. Close the breaker to connect the system to power, and verify the fuse inside the controller module is in place. The clock controller (located on the door) will come on a few seconds later and read 12:00.
26. Follow the procedures of SOP 151 for installing the pumps (section 4.2.4) and completing a sampler function check (section 4.2.5) to complete the installation of the controller module.
27. Review the wiring diagram in Figure 2 to resolve controller module malfunctions.

**Figure 2 IMPROVE Controller Module Wiring Schematic**

